An Educational Resource for Information Literacy in Higher Education: Visibility and Usability of the e-COMS Academic Portal

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Abstract

As in today's knowledge society the Internet is playing an important role in the information literacy of university students the goal of this paper is to analyse, after its first year on the Web, the informational impact of an e-learning resource developed by Granada's University lecturers (the e-COMS educational portal), a pioneer in Spain for training in information literacy. From the objective and subjective data provided by the own portal and by it users, two different and complementary kinds of analysis (functional and users') are performed. Assessment of various capabilities, among which visibility and usability stand out, is provided. The highly positive but improvable results offer a detailed analysis of the functional aspects of the portal itself and of the users' relations with this information resource. From these analyses strengths and weaknesses are extracted and some proposals for improvement are derived

1. Introduction

The commitment of the universities of Spain to the Internet, as a privileged means of communication in teaching, research and management, is in turn part of a concerted movement at the European level to reform and integrate its universities in parallel with the EU's commitment to the Knowledge Society (CCE, 2002). Thus, there are more and more lecturers and educational communities interested in designing portals and learning objects as instruments for confronting the new challenge of meaningful, life-long learning, based on the acquisition of abilities, skills, values and competencies (OCDE, 2005). Also as Keller points out (Okerson, 2003), we need synthetic and cooperative web portals that cover everything about a discipline, creating small digital libraries. But that the design of information literacy programmes should incorporate the user's view, because on the contrary they would be pedagogically inappropriate (Maybee, 2006). Likewise, experts and lecturers should be involved in the design of educational portals, placing emphasis on both design and selection

and implementation of the contents, using criteria of accessibility and usability (Nielsen, 2000, King, 2005).

The academic portal e-COMS (*Electronic Content Management Skills*) started in November 2004 as an initiative of an interdisciplinary group of lecturers from several universities and disciplines (information science, education, and computer science) of Spain to serve as platform for blended-learning in the domain of information literacy, particularly in those topics related to the management, organization, representation, assessment, and retrieval of electronic contents, providing the students with a helpful environment for the acquisition of their own knowledge base, skills and resources.

2. Background

In today's knowledge and learning society, in which virtual learning and the partial presence of the teacher are gaining importance, there are many tools that libraries and teachers can use to foster student autonomy and training in information literacy, ranging from content portals, learning platforms, tutorials and thematic dossiers to content repositories. But all these offers have to be organized, systematized, and disseminated, so that they are visible and useful to students. Institutions of higher education are becoming more and more aware of how important it is to ensure this type of training which provides students and graduates with the capabilities to face more heterogeneous information whose authenticity, validity and credibility have to be continually established, and to acquire and develop aptitudes that will be transferable and usable throughout life. Besides employers require graduates technologically skilled, with the ability to seek and assess information in electornic sources and on the Internet, to manage internal and external information and to carry out warning activities.

2.1. e-COMS objectives

The e-COMS portal, co-financed by the Office of the Vice-Rector of Planning, Quality and Teaching Assessment at the University of Granada and Consejeria of Innovation, Science and Business, was designed in 2004 being officially presented at the Granada's Faculty of Library and Information Science on 10 November 2005. This innovative educational project within the framework of European convergence arose from the intersection of three key elements: the European dimension of higher education, which is expected to provide students with a set of abilities and skills for the management, analysis and assessment of information; the socio-constructivist educational proposition, with the significant prominence

of e-learning (Wiley, D.A., 2000); and the information literacy paradigm (ALA, 2005, CAUL, 2005, IFLA, 2006) as a key competency in the generic training of students. The e-COMS philosophy is to collaborate in autonomous student learning, favouring both interaction and the sharing of knowledge such as the strategic acquisition of information-related abilities and skills so that the student can manage and update knowledge, select information, learn about valuable resources and understand what is learned. This is the spirit of e-COMS, born with the generic objective of being an educational portal oriented to training and education in information science by supplying a set of cognitive, technological, information, research and communicative skills and competencies.

The e-COMS portal has set itself the following specific objectives:

- To be an interactive portal to "learn how to learn" and to train university students in information literacy.

- To be a training, reference and information portal for students in the field of Library and Information Science and Educational Psychology, although the portal has also been piloted in technical areas.

- To train students on strategies and techniques for the analysis and synthesis of information, offering criteria for its organization and representation.

- To reveal the specific instruments for searching, retrieval and evaluation of information, with special emphasis on know-how.

- To teach students how to use synchronous and asynchronous communication systems in the process of the creation and exchange of knowledge.

In short, e-COMS is an educational portal addressed to autonomous university student learning in information literacy whatever the student's area of specialization. It aims to give students autonomy in information management and the acquisition of new cognitive skills in the new knowledge economy environment (Pinto, Doucet, 2006, in press). Following the conventional structure of scholar portals (Jafari, 2003; Campbell and Aucoin, 2003, FORMIST, 1998) a web site of this kind can contain information on current events in the domain, conceptual information, exercises, activities, questionnaires, tutorials, tools, resources, etc. In e-COMS the following types of information are offered:

- **general**: related to the objectives and goals of e-COMS, its philosophy and design, credentials and work team, site information including site map, ethical code, and data on the creation and updating of the portal pages.

- **conceptual**: coming from the literature in use, derived from the experience of experts and authorized sources, organized by thematic categories and subcategories and following the criteria of the main norms of information literacy (ALA, 2005; CAUL, 2005; SCONUL, 2004; DHI, 1995; …). The information is structured as follows: summary, general concepts, methods and procedures, examples, and both bibliographical and electronic tables of skills-competencies and resources. This structure allows for easy reading and understanding in the overall organization of the portal.

- **procedural:** related to the skills and competencies needed for channelling and duly taking advantage of meaningful learning, based on the main concepts synthesized and conceptualized for problem-solving.

- **technical:** related to the correct use of the portal, emphasizing the role of the tutorial in the explanation of specific symbols, correct printing, how the search engine works, allowing the navigation within the portal by means of key words that lead to the demanded page or selecting from a semi-controlled list of key words those that are of interest, offering advanced search options.

- **documents:** this includes several types of complementary information out of the portal are included:

    - **Dossiers** with diverse aid material: electronic material, which compiles academic web pages, on-line scientific articles, tutorials, portals, etc. complemented with conceptual information; and bibliographic material that include the best sources for the topics under consideration.

    - **Services**. e-COMS offers a careful selection of generic resources available on-line that are useful for learning, such as dictionaries, encyclopaedias, software, freely available electronic journals, digital libraries, portals, and search engines.

- **communicational information:** allowing both synchronous and asynchronous communication, using e-mail for addressing questions to the portal Coordinator,

María Pinto, professor of Information Science at the University of Granada, or to any of the members of her team; the suggestion box; and above all the use of the forum to exchange ideas with other users and to incorporate topics for debate, opinions, etc.

3. Methodology

Now that the portal has been working on line for a year, with some 12.000 visits, functional and users analyses will provide us both its visibility within the principal internet search engines (Google, Yahoo! and Altavista) and its usability based on users' opinions. A first and unavoidable step consists of the data collection to be analysed.

3.1. Data source

The data for the analyses come both from the portal itself, collected from the server statistics and on-line questionnaires, and from information collected in the classroom using different procedures (web usability sessions and the talk aloud method). For the visibility studies, a simple search strategy was used with the following key words: "e-coms", the official acronym of the portal, the spelling without the hyphen, "ecoms" and the long name of the portal "Electronic Content Management Skills". The first 30 results from the search engines were analysed, as they carried a bit amount of information.

For the functional analysis, information was extracted from the webstats4u counter (http://www.webstats4u.com), available on the University of Granada server, where the portal was initially located until July 2005 (http://mpinto.ugr.es/e-coms). However, a problem of computer sabotage kept the portal inactive from May to July, and that circumstance compelled us to improve security measures by relocating it to a private server [1]. This is a free statistics programme, which can be used in any platform or browser. It counts each visit based on its IP within a margin of one minute and uses reserve copies in case of data loss. The program offers a summary of the visits, the last 10 visitors, page viewing by the day and the country of origin. How the users arrive at the portal, through which search engine, key words, sites, and links can also be analysed.

[1] Transfer to the new server was carried out on 19 July 2005. As web server, web Apache (1.3.34 Unix) was used, which uses Linux (Kernel version 2.6.12-1.1447_FC4smp), PHP (4.4.2.) language and MySQL (4.1.18-standard) as data base system.)

For the users' analysis, the answers from 152 users who anonymously filled in a questionnaire available on the portal between January and February 2006 were used. This is is little time consuming since in only few minutes it collects information on central aspects of the portal that may be transferred to a MySQL (4.1.18) database to be analysed on the base of queries made in SQL language to obtain the different conclusions. Also the information collected from the test of usability taken by a group of students in the Information Science degree programme at the University of Granada was used

3.2. Methods

The quality of electronic information pertaining to the education resources available on World Wide Web has been studied from different viewpoints and approaches. Firstly, descriptive-comparative studies on information contents and services stress evaluation of the resource visibility as a function of the presence/absence of information on Internet and the identification of relevant information (Middleton, McConnell and Davidson, 1999). A second type of studies approaches accessibility through search engines, catalogues and repositories, i.e. that once the resource becomes available the information should be accessible and usable. Accessibility through search engines –the most employed by users access method— is an important research field, which even deserved the interest of the journal *Nature* (Lawrence and Giles, 1999). Usability can also be measured through the talk-aloud method (King, 2005), which allows us to know directly and out loud what aspects the participants are evaluating, what they are looking for and what they need it for, how they feel about the information found, what information they have not found but still need, what aspects of the web site they feel can be improved, etc.

In third place, discussion about the information quality on Internet has in recent years focused on aspects related to user satisfaction, first from a qualitative point of view, proposing models based on the theoretical drawing up of batteries of practical advice (Corry, Frick and Hansen, 1997), and subsequently looking for indicators allowing an automatic evaluation (Koehler, 1999, 1999b; Bar-Ilan, 2000). Moreover, the detection of qualitative indicators has opened the door to the analysis of quantitative indicators which can be collected by a search robot. This line of research, closely connected to the previous one, but offering complementary advantages, such as the extraction of data no matter the human judgement or the extent of the studied sample, is rapidly growing as the numerous available studies witness (McKiernan, 1996, Rousseau, 1997).

Finally, the cybermetric research line deals with the quality of information resources on the Web as a function of the resource quotes and its social impact. Though the use of bibliometric methods to assess Internet was already foreseen by W. Paisley (1990), the specific studies on the Web range from the pioneering work of Almind and Ingwersen (1997) (Denmark) to the more recent works by Smith and Thelwall (2002) (Australia), Thelwall (2002) (Great Britain) and Pinto et al. (2005) on (Spain). These studies allow us to make some inferences on the impact of university scientific production that may be similar to those obtained in bibliometric studies. In summary, the diversified and complementary methodology employed along the research allows us to uncover the e-COMS visibility and usability indicators. The intended methodological integration ranges from qualitative and quantitative methods to inductive and deductive ones.

3.3. Data analysis

After a superficial study of the portal overall data, criteria for the qualitative and quantitative analyses were established, taking into account the standard found in the literature and our previous experience in quality assessment of academic web sites (Pinto et al., 2005). Twenty assessment criteria were defined and grouped into three categories: *searchability, visibility and usability*.

For the collection and later analysis of the data two instruments were designed: by one side, an Excel template for the data record to warrant the work consistency and to allow comparisons with subsequent studies; and by the other, a MySQL (4.1.18) database for the data storage from the questionnaires and their easiest processing and interpretation. Once collected the information, a multidimensional data analysis regarding the quantitative and qualitative variables derived from the statistical data recorded by the server, the field of study and the users' opinions was developed.

Firstly, an overall statistical analysis of the portal was carried out taking into account the number of the portal users, their original country and institution, the number of visits per page, in order to know which were the most demanded pages and thus of greater interest, the ratio of users by number of visits, in order to learn the percentage of users who visit the same pages several times, the duration of the visits, as well as some generic measurement characteristics relating to web size, document size, hypertextual analysis, links, endogamy index of the portal and web diameter. To this end, the Excel-based descriptive statistical method in order to obtain the data and interpret the results, accompanied by graphs and tables, was employed.

Secondly, a more in-depth quantitative analysis considering the information coming from various sources was made:

- Statistical data recorded on the servers where it had been located (with the webstats4u programme)
- Data resulting from the observation procedure using several search engines (Google, Altavista and Yahoo!)
- Test of usability carried out in the classroom with a sample of students, using the talk aloud method (King, 2005). A 90-minute work session was organized to learn their opinions on the following aspects associated with the portal: content, navigation and design.

Thirdly, a qualitative analysis was carried on the base of the data collected from the on-line questionnaire located on the portal home page (http://www.mariapinto.es/e-coms/cuestionario_e-coms/cuestionario.htm), in order to know the kind of users, the information they are looking for, the most used pages, and above all to learn of their suggestions for improvement.

4. Functional analysis

In order to get an overall idea of the portal use, statistical data from the server relating to the portal's first year of existence (November 2004 to December 2005) were analysed regarding the following criteria: total numbers of visitors and visits, relation number of users by number of visits, duration of the visits, ratio of visit per page, searchability, visibility and usability.

4.1.. Total number of visitors

For the studied period, from October 13 2004, that is the date when the statistical programme was installed (although the portal came out on November 10), to the data collection date in December 2005 (with the exception of two months of inertness owing to technical problems with the University of Granada server security) the number of visitors was almost 10,000 (9.888), with a total number of visited pages of 104,818.

4..2. Number of visits

The total number of visits during this first year was 12,162, distributed by countries.

Spain ……	8992	73.94%

Argentina ……	1403	11.54%
Mexico ……	504	4.14%
Peru ……	121	0.99%
Venezuela ……	112	0.92%
Cuba ……	111	0.91%
United States ……	104	0.86%
Chile ……	96	0.79%
Colombia ……	93	0.76%
Portugal ……	80	0.66%
Czech Republic ……	79	0.65%
Denmark ……	72	0.59%
Belgium ……	71	0.58%
Finland ……	68	0.56%
Germany ……	66	0.54%
Italy ……	65	0.53%
Unknown ……	125	1.03%

Table 1. Absolute number and ratio of e-COMS visit

Spain is the country with the greatest number of visits, 73.94%, followed by Argentina with 11.54% and Mexico with 4.54%. The rest of the countries offer low ratios that are under 1%. This situation can be explained regarding the language of the portal, Spanish language, and the fact that it was disseminated with a mailshot to Spanish-speaking distribution lists. However, it is worthwhile to be known that it has also been used by visitors from other language communities.

Spanish		**Other Languages**		**Unknown**
Spain	8992	United States	104	125
Argentina	1403	Portugal	80	
Mexico	504	Czech Republic	79	
Peru	121	Denmark	72	
Venezuela	112	Belgium	71	
Cuba	111	Finland	68	
Chile	96	Germany	66	
Colombia	93	Italy	65	

Table 2. Spanish and others countries e-COMS users

4.3 Relartion number of users by number of visits

Number of Visits	Number of Users	% of the Total No. of Single Visitors
1 visit	4858	49.13
2 visits	920	9.30
3 visits	536	5.42
4 visits	414	4.19
5 visits	481	4.86
6 visits	356	3.60
7 visits	448	4.53
8 visits	538	5.44

9 visits	529	5.35
10 or more visits	809	8.18

Table 3. Number of users by number of visits

More than half of the visitors had a medium to high degree of fidelity, since they are users with more than two visits, with the users visiting the site more than ten times reaching 8.18%.

4.4. Duration of the Visits

This is an important measurement indicator for evaluating the performance of the portal. If we compare the data in table 4 it can be seen that it is correlated with the previous chart regarding the number of users/number of visits, since half the visits last 1 minute or less and they are generally from visitors who entered through a search engine but did not find the information they were looking for. However,

A very significant number of users (48%) are in the band ranging from 2 and more than 19 minutes. This is important since it corresponds to real and faithful users of the portal, who consult it assiduously for their training in information skills and competences.

Visit Duration (minutes)	Visits	% of the Total No. of Visits
0-1	5196	52.55
1-2	280	2.83
2-3	264	2.67
3-4	220	2.22
4-5	290	2.93
5-6	175	1.77
6-7	160	1.62
7-8	155	1.57
8-9	243	2.46
9-10	240	2.43
10-11	238	2.41
11-12	231	2.34
12-13	233	2.36
13-14	228	2.31
14-15	223	2.26
15-16	221	2.24
16-17	220	2.23
17-18	220	2.22
18-19	217	2.19
>19	632	6.39

Table 4. Visit duration

4.5. Ratio of Visits per Page

This indicator gives us information on which pages are the most visited and consulted, on the base either of the topics interest and novelty, the profile of the users themselves or the dimension of the tool as a support resource for self-learning in information education. The obtained results from the 15 most visited pages are displayed in table 5.

Information-Digital literacy ……	12559	11.98%
Research Initiation ……	11533	11.00%
Organization, Filtration and Representation of Information ..	11021	10.51%
Information Needs ……	9483	9.05%
Quality and Assessment of e-Contents ……	7945	7.58%
Tutorial ……	7176	6.85%
e-Contents ……	5895	5.62%
Introduction ……	4613	4.40%
Services ……	4101	3.91%
Forum ……	3588	3.42%
e-Contents Management ……	2819	2.69%
Editing e-Contents ……	2563	2.45%
Information Search and Retrieval ……	2307	2.20%
Objectives ……	2264	2.16%
Team ……	2184	2.08%

Table 5. The most visited pages

The most visited page was *Information Literacy* (11.98%), since it is the star topic of the portal, and a pioneering and innovative one within the current framework of the European Higher Education Area (Pinto, 2006). It includes the most important international norms and programmes for training in skills and competencies in the use, management, processing, assessment, retrieval and dissemination of information. The next most visited page was *Research Initiation* (11%) which goes deeply into the principle of scientific thought, the processes of creation, innovation, research methods and techniques that contribute to the learning process and the design/planning of research works, followed by *Organization, Filtration and Representation of Information* (10.51%), which explains how to organize e-contents, analyse, process, filter and represent them synthetically using techniques of outlining, graphic representation, and summary. Next comes the page on *Information Needs* (9.05%), focused on describing the importance of the concept of information needs so that students can learn to define search criteria, formulate proper strategies and use the necessary tools. This page is followed in importance by *Information Quality* (7.58%) –used very often as complementary material in the preparation of some courses- which offers a series of criteria to help the student to filter e-contents and discern veracity, credibility, reliability and, in short, quality in the information afforded by this medium. The page on *e-*

Contents is the next most visited (5.62%), and highlights the importance of contents without borders and integrated into networks, where anyone can create, re-create, modify and re-use them. The page focuses on their characteristics and properties, forms of presentation, how they are generated and their structure and presentation on the web.

4.6. Searchability and visibility

The presence of educational portals on the web is growing and their designs vary according to the interests of their creators, the topic in question, the institutions involved and the persons they are addressed to. But not all designers have been concerned with optimizing the searchability of the site, with improving its visibility to make information acquisition easier or with facilitating the usability and accessibility of the contents and added-value services that the portal generates (Nielsen and Tahir, 2002). Some experts point out five basic criteria for the effective designing of web sites (Baeza and Rivera, 2002): *searchability, visibility, contents, aesthetics and reliability*. Although all of these aspects are important, we have prioritized in this study only those related to the contents, and in particular we shall analyse the searchability, visibility, and usability of the e-COMS portal.

Searchability entails title of the portal appearing within the home page, being registered in the principal search engines. Though there is no unanimous agreement as to which aspects determine high visibility on the search engines it seems advisable, according to experts opinions, to be registered with the main search engines, and have a standardized HTML code, descriptive metadata of the site and a high page ranking. Baeza Yates propose the following measurements of searchabiltiy:

- Whether the search engine finds the site
- Absence of obstacles for the robot
- Text of the organization clearly located
- Position of the portal in the search engines
- Metadata on contents and intellectual property

Closely related to searchability is the visibility criterion, which involves being on the Web in such a way that the portal can be found and visited by any user. The study of visibility can be done on three levels (Pinto, 2004, p. 347). The first refers to whether the information of interest to the users is or not really available on the Internet. The second looks at the quality

of the information, i.e., that it is complete, authorized, multimedia, true and up to date. The third level would analyse the usability of the portal, assessing to what point the information is suitably presented so that is "usable" to any user. Hence, usability entails the application of a series of methods addressed to making the web site easy to use and learn from. According to Baeza and Rivera (2002) usability can be measured according to these criteria: organization of contents, formal aspects, user loyalty and accessibility in design. We shall now take a look in detail:

The criteria used to measure the visibility of e-COMS were:

- *Information on the home page*: analysing the ease with which a user enters a second level from the home page as well as the logic with which the information is organized in order to get a fast access.

- *User friendliness and intuitive nature of the portal*: a consideration of how easy it is to find the information intuitively.

- *Table of contents*: taking into account the existence of a table of contents on every page that allows the users to know where they are, or a menu that contains information on each category so that the user can know at any time how to navigate and locate the desired information.

- *Ownership of search engine*: as a user aid for solving information needs without having to analyse the whole web site, and with the possibility of advanced search or restricted search.

- *Compatible design*: so that the web site can be seen from different navigators without distortions in the portal's visibility. The navigators most used are Explorer, Nestcape, Opera and Mozilla. Although Explorer is one of the most used, it is important to take into account other possible alternatives in order to reach the largest number of users.

- *Impact factor*, according to the following elements:

    - *Analysis of the received links*. To obtain this information we used the advanced search option in Google: find pages with links to the "e-COMS" web site with the following url http://www.mariapinto.es/e-coms). Google found 36 pages that had links to e-coms, from 3 different countries (Argentina, Venezuela, Spain, and with a ".com" domain)

- *Page Rank*, which for the e-COMS portal is 5 out of 10. The Page Rank is the importance Google assigns to a page as a function of an automatic calculation which takes in factors such as the structure of links with the web and many other variables.

- *Positioning*, making possible to know whether the page can be found by search engines and whether it appears in the first places of the search results. E-COMS have a good positioning, since if you look in Google for “e-COMS” or “Electronic Content Management” it comes up first.

To learn the visibility of the e-COMS portal searches were carried out on Google, Yahoo! and Altavista on December 11 2005 using the terms “*e-coms*”, “*ecoms*” and “*electronic content management skills*” since the official name of the portal is the acronym *e-coms* and its title is the whole developed name. The orthographic variant “ecoms” was used as a guarantee of success for any users who did not know the correct spelling of the portal name. Visibility analysis is very useful for finding out what sites had links to the portal and from where it is linked. From the search results using each of the mentioned variants, only the first 30 results were examined and displayed in Table 6.

Link	Google	Yahoo	Altavista
ALFIN: Alfabetización informacional	e-coms		e-coms
Biblioteca y Documentación Educativa	e-coms	e-coms	e-coms
Bradomín. Una brújula personal en la Red	e-coms; ecoms	e-coms	e-coms; ecoms
Cátedra procesamiento de datos	e-coms	e-coms	e-coms
CICIC	e-coms; Electronic Content Management Skills		
Cnice	e-coms; Electronic Content Management Skills	e-coms; Electronic Content Management Skills	e-coms; Electronic Content Management Skills
Corporación Nacional Universitaria	e-coms		
Cybermetria Portal de estudios cuantitativos en Internet	e-coms		e-coms
El portal educativo del Estado argentino	e-coms	e-coms	e-coms
Escuela Universitaria de Enfermería y Fisioterapia. BIBLIOTECA. Universidad Salamanca	e-coms		e-coms
FORO DE PROFESIONALES DE LA INFORMACION (PROINFOROMX)	e-coms; Electronic Content Management Skills		
Gobierno de Mendoza, Dirección general de escuelas	e-coms		
Instituto Nacional del Agua, Argentina	e-coms		
Junta de Andalucia	e-coms		
Managemente.com	e-coms; Electronic Content Management Skills		
Monografías.com	e-coms; Electronic Content Management Skills	e-coms	
Presidencia de la Generalitat Valenciana	e-coms; Electronic Content Management Skills	e-coms; Electronic Content Management Skills	e-coms; Electronic Content Management Skills
REBIUN	e-coms		e-coms
Secretaría de Políticas Universitarias – Ministerio de Educación Ciencia y Tecnología	e-coms	e-coms	-
Sisbi	e-coms	-	-
Univeridad de La Coruña	e-coms	-	-
UNIVERSIDAD CATÓLICA DE OCCIDENTE	e-coms	-	-
Universidad de Granada	e-coms; Electronic Content Management Skills	e-coms	e-coms
Universidad nacional de Cuyo	e-coms; Electronic Content Management Skills	Electronic Content Management Skills	-
UNIVERSIDAD NACIONAL DE ENTRE RÍOS	e-coms	-	-
Universidad Nacional de Río Cuarto	e-coms	-	-
Universidad de Malaga	ecoms; Electronic Content Management Skills	e-coms	e-coms; ecoms

Link	Google	Yahoo	Altavista
InternetLab: Observatorio de Ciencia y Tecnología	-	e-coms	-
CONSEJO NACIONAL DE EDUCACION SUPERIOR – ECUADOR	-	e-coms	e-coms
Comisionado do Espacio Europeo de Educación Superior universidad de Vigo	-	e-coms; Electronic Content Management Skills	Electronic Content Management Skills
Blogs Ya.com: Nursing Care in the Mediterranean Arena	-	e-coms	e-coms
biblioteconomia y documentación universidad de Burgos	-	e-coms	e-coms
The World of the Blog askain.blogspot.com	-	e-coms	-
Buscador swobee.com: impresora virtual	-	-	e-coms
Buscant informació: guies temàtiques – Biblioteconomia , Documentació I Arxivística	-	-	e-coms; Electronic Content Management Skills
Evaluación digital	-	-	e-coms
Buscador MaxiBuscador.com: mapas conceptuales	-	-	e-coms
BIBLIOTECONOMÍA, DOCUMENTACIÓN Y ARCHIVÍSTICA	-	-	e-coms
Biblioteconomía y documentación	-	-	e-coms

Table 6. e-COMS search engines, keywords and links

A deeper analysis of table 6 for each of the regarded search engines was carried out later, with the main goal of knowing which are the linked domains and the repeated ones.

The e-COMS portal has excellent visibility through Google as 38 links were found with the official acronym of the portal (e-coms), the majority of which domains of Spain (.es), followed by Argentinean (.ar) and commercial ones (.com). Using the term “ecoms” only 2 links appeared, both from Spain, whereas when using the complete name of the portal **“**Electronic Content Management Skills”, 10 links appeared with the domains .es, .com and .ar.

e-coms	Gov.ar	3
	Edu.ar	10
	Uba.ar	1
	.com	7
	.es	16
	Edu.sv	1
Ecoms	.es	2
Electronic Content Management Skills	.es	6
	.com	3
	.edu.ar	1

Table 7. e-COMS links through Google

In the Altavista directory the portal e-COMS has also a good level of visibility, receiving a total of 26 links when using the term “e-coms”, 2 links with “ecoms”, and 6 links using “electronic content management skills”.

E-coms (26 links)	.es	16
	.com	7
	.ar	2
	.net	1
ECOMS (2 links)	.es	2
Electronic Content Management Skills (6 links)	.es	6

Table 8.

In Yahoo!, however, the e-COMS portal received fewer links: 16 with “e-coms,” 4 with “electronic content management skills” and none with “ecoms”.

e-coms (16 links)	.es	9
	.ar	3
	.com	3
	.net	1
Ecoms (0 links)		0
Electronic Content Management Skills (4 links)	.es	4

Table 9. Yahoo´s links of e-COMS

The only common link to the three search engines was the CNICE (National Centre for Educational Information and Communication, available at http://www.cnice.mec.es/, which pertains to the Spanish Ministry of Education and Science and is aimed at the integration of

ICT in schools, for teachers, young people, parents or other adults. Anyway, the visibility of the portal is high and shows a clear national and international scope, especially in Spain and Latin American countries.

4.7. Usability

Concerning web site design, *usability* is an emerging research topic, as can be seen in the specialized literature (Badre, 2002; Bawa et al, 2001; Brinck et al, 2002; Chandler and Hyatt, 2003; Clauson, 1999; Dustin et al, 2002; Graham, 2002; Holmes, 2002; Krug, 2000; Nielsen, 1999, 2002; Norlin, 2002; Pearrow, 2002; Wroblewski, 2002, Pinto et al., 2005). Nielsen (2000) defines *usability* as a qualitative attribute that evaluates the ease of use of an interface, and situates it proactively with the methods that can be used to improve this ease of use during the design process. Usability refers to the relationships between tools and their users. […] it is the quality of a system that makes it easy to learn, easy to use, easy to remember, error tolerant and subjectivity pleasing (Campbell and Aucoin, 2003). Among the sub-criteria that define the usability of a web site we have analysed the following issues:

- **Accessibility**

The e-COMS portal fulfils the W3C Level A accessibility guidelines, according to the TAW Test (Web Accessibility Test), which enables us to verify the level of accessibility reached in the design and development of a page. *Accessibility* is conceived as a web site's capacity for being understood in its totality by all users, regardless of the physical and technical conditions of Internet access (Pinto, 2004, p.356). As Campbell and Aucoin (2003) point out, site accessibility refers to both technical and social information. For example, the information should be available in more than one format, especially if plugs-in, increased bandwidth or other tools are required for viewing: multimedia elements should be integral rather than superfluous; graphical elements should respect cultural diversity; and the perceptual, physical and cognitive challenges of a diverse user population should be addressed. The design of the e-COMS portal was initially intended to make the information accessible to all and especially to students with a disability (http://www.tawdis.net/taw3/cms/es/infotaw/que.html). A correct printing, an optimal resolution for the most common navigators and a help tutorial were also our preferences.

- **Navigability**

Navigability is important when the problem is to locate the desired information. The elements usually taken into account are an always visible and in the same place menu of contents,

consistency in the terminology employed, the presence of navigation buttons (Pinto, 2004) and hypermedia design, of great importance to users as in Marchionini's words (1992), "the user wants to achieve his/her goals with the minimum of cognitive load and the maximum of enjoyment". The essential components of an effective hypermedia environment relevant to learning portals are: web-defined goals and explicit scaffolding support such as those provided by intelligent agents and coaches (Guzdial and Kehoe, 1998); authentic learning environments in which knowledge is socially constructed in formal and informal shared spaces (Denning and Smith, 1998); multiple representations of content (Gillham and Buckner, 1997); navigational / cognitive devices such as spatial and conceptual maps and tutors; the selective use of outsiders or virtual guests, for complementary insights and information; and collaboration (McLellan 1997).

The planning of the different navigation resources and strategies for the portal design was a basic step in order to achieve optimal outcomes at the time of information location. We took into account the importance of the presence of a contents menu visible in all the pages, and the route of each page so that the user can go back at any moment. Moreover, the following elements were analysed:

- *Site map*, with links and a table or menu where the information contained in the site would be adequately structured and described to make it easy for the user both to navigate the site and locate the most important contents. The e-COMS portal has a menu on the left side that is always shown, with star and shell icons each representing a category. As the mouse touch the icon, the name of the category appears. Thus, the users can never get lost and can find the information they are seeking.

- *Web search engine*, analysing the internal search engine so that it can help the users to rapidly solve their information needs without having to navigate through the entire portal (Alexander and Tate, 1999). It is very important that the search engine should be effective and give the opportunity for advanced searches while warranting a certain amount of control over the vocabulary. E-COMS offer the possibility of searching by semi-controlled key words as well as restricting the search. It offers a link from the results to the page in question as an aid to the user.

- *Communication services*. One element that always improves the usability of a site is an e-mail address where one can contact the webmaster or portal coordinator in order to clear up questions and make suggestions. The e-COMs team is highly

receptive to user comments. Another important service is the forum that fosters the exchange of information among users.

In general, it can be affirmed that *usability* and *visibility* are two concepts that interrelate and complement each other. It is even difficult to dissociate a set of criteria that are so strongly connected.

As stated previously, a usability test was also applied in order to evaluate the portal, using the talk aloud method (King, 2005), the results of which served as a basis for the subsequent design of the on-line questionnaire. The study employed 30 users randomly chosen, graduates in library science and students from the final year of the Information Science degree programme at the University of Granada, who participated in individual web-usability sessions. The study was based on the response to a battery of 12 items to observe and identify the Web-use efficiency and effectiveness of faculty and graduate students actively engaged in learning and research information literacy (Mack et al., 2004). Besides the participants, the session included a moderator (professor) and an observer (assistant researcher). The moderator was charged with leading the participants through the required steps. The observer's role was to note incidental information about the performance of each task that later could be compared with the electronic information and the students comments. For each item of the usability test, the moderator read the question aloud and then gave an electronic copy to the participants so that they could complete it. The questions were grouped into three categories: content, navigation and design, each with its elements, and a final section of comments. It was assessed on a scale of average, good, very good.

CONTENTS	AVERAGE	GOOD	VERY GOOD
Detailed information ……			X
Logical organization of information ……			X
Relevance of links to the outside ……..			X
Date of last up-dating (if less than 3 months, very good) ……..		X	
Clear and well-identified sources of information ……..			X
NAVIGATION			
Ease of movement (forward-back, return to home page, site map) .			X
Easy understanding of navigation buttons ……..			X
Quality of the search tool indexing the site map ……			X
Speed of site loading and loading of the different pages ……..		X	
DESIGN			
Site design and colours used ……			X
Text legibility ……			X
Quality of print version ……		X	

COMMENTS

Table 10. e-COMS usability test

The lecturer read the questions out loud (talk aloud method), as the students filled in their answers. The first task was to discover the availability of a category in the portal from the main menu to see if the information was detailed and logically organized. In a second step the participants were asked to determine whether the information was available at another site, to assess the relevance of the outside links, as well as the up-dating, because if the link does not work it means that the portal has not been properly up-dated. The third task consisted of going back to previous pages and completing certain information to test the ease of navigation and understanding of the navigation buttons. For the fourth task participants were asked to find some information on a specific subject, to test the quality of the portal's search engine. These two tasks, which are related to the portal navigability, allow us to see the loading speed of the different pages. Regarding design, the legibility of the site as well as the printing quality, were tested. The last part of the test was an open question for collecting comments. There were few responses here, addressed to improving the design, in particular related to how fast the pages load.

Besides the criteria of searchability, visibility and usability already analysed, we would like to emphasize the importance of metric studies in order to analyse and interpret the structure, size and connectivity of a web site (Koehler, 1999; Bar-Ilan, 2000; McKiernan, 1996; Rousseau, 1997), starting from information related to the type of servers, files, labels, characteristics of links and web site size. The following elements have been analysed:

- *Web Size*, based on the number of nodes of the documents: 40 nodes.
- *Document Size*, which allows us to compare the size in bytes of the different web pages. In e-COMS the sizes range between 304 KB and 1 KB, 88 KB being the mean and 3506 KB, the total size.
- *Links*, which allow us to measure and know the degree of connectivity of the e-COMs portal and it number of links. The following elements were studied:
    - Hypertext analysis, i.e., the number of links to the site, which in the e-COMS portal is 49.
    - Hypertext link development index (Ellis, 1994, Parunak, 1989), understood as the quotient of the number of nodes divided by the number of links, so that a lower index indicates better connectivity. The e-COMS index was acceptable (0.816).

- The endogamy index (Aguillo, 2000), which measures the quotient of the number of internal links divided by the total number of links, so that the lower the index the less endogamy in the site. E-COMS has 588 external links and 54 internal links, so that the endogamy index is calculated thus: 54/(588+54) for a quotient of 0.084. According to Berrocal (2004), this number indicates that the portal does not suffer from endogamy, since both its links and information flows from the site are not to the same page that has the link, but rather to pages different from those it links, thus enriching the value of the link itself.

- *Web Diameter* is the maximum distance one has to go to reach a certain document (Albert et al, 1999; Faloutsos et al, 1999). If a domain has a large diameter this means that there are areas in its structure that are more difficult to reach. The e-COMS portal has a web diameter of 2, which means that it is quite easy to reach all its areas.

- *Stratum Analysis* tells us whether the site is designed so that one can access any place from any page, making the most of the advantages of its reticular nature. In the e-COMS portal the stratum has a value of 0.047125, meaning that the web site is well linked.

5. Users analysis

Batson (2000) suggests that a learning portal expands on traditional academic space, which has been defined as a physical infrastructure –with related resource structures- that shapes the nature of the interactions that occur within it. This traditional space has an important social function: members of the community know how to speak and act within these spaces, understand power relationships by the way these spaces organize interactions and, once acculturated, can subvert the purposes of these spaces. The nature of teaching and learning has been entirely defined by a familiar landscape, where learning events were structured by place, time and format.

To have a suggestion box that collect users' expectations and information needs constitute an important issue. This would help to design a web site adapted to users (Nielsen, 1999). Also important is the presence of a satisfaction questionnaire about the web site, which would obtain data for the web designers on users' tastes and behaviour, and which could serve to build adapted web pages. Quality assessment of academic resources is a strategy for completely exploiting those resources and improving the procedures and performance of

any system or organization, especially those of public services (Sloim and Gateau, 2001). Usually taken into account are those issues related to the web site policy of quality, making explicit its mission, goals and objectives, having a suggestion box and a satisfaction survey. E-COMS meet most of these requirements.

Qualitative analysis was mainly carried out using data extracted from the on-line questionnaire implemented in the portal on 12/12/2005 and which collected information from January 2006 to February 2006 by anonymous users (152). The information collected from the classroom usability test "item commentaries" was also processed (December 2005). They were also encouraged to provide suggestions for improving the web-site (Chanlin and Chang, 2003). From a critical analysis of the collected data in the questionnaire the following results were extrapolated around users, portal, contents, visibility, usability and comments criteria:

5.1. Users

- *Academic level of the users*

Most of the users who answered were second cycle students. There may be two reasons for this to occur: by one side, e-COMS is a resource used by many of the e-COMS team as a support in the second cycle teaching; by the other, the second cycle students are about to finish their official learning process. At this key moment they are becoming aware of the importance of autonomous learning in information skills and management.

First Cycle …….	15	9.87%
Second Cycle …….	128	84.21%
Others ……..	9	5.92%
Total ……..	**152**	**100.00**%

Table 11. The e-COMS surveyed population

- *Knowledge of computers and handling of information*

Regarding the level of computer knowledge of the users at the time of coping with academic portals, we can see that the majority are in the very good and good categories, since many of them have received training courses in the matter and use some type of software for information processing.

Excellent ……..	16	10.53%
Very Good ……..	88	57.89%
Good ……...	45	29.61%
Normal ……...	3	1.97%
DK/NR ……...	0	0.00%

Total ……..	**152**	**100.00**%

Table 12. Knowledge of computers of e-COMS users

In relation to the handling of information skill, half of the surveyed population believe that they have a very good (50%) or even excellent (28.95%) level in information use, while very few consider that they have an average level (6.58%).

Excellent ……...	44	28.95%
Very Good ……...	76	50.00%
Good ……	22	14.47%
Normal ……..	10	6.58%
DK/NR ……...	0	0.00%
Total ……	**152**	**100.00**%

Table 13. Handling of information skill of e-COMS users

5.2. Global assessment

- *Introduction and overall assessment*

Concerning the portal usability, and particularly the item asking how the users were introduced to the portal, almost 75% was introduced by a lecturer in the classroom, whereas others (10.53%) by consulting librarians and very few through the Web (4.61%) or the recommendation of a colleague (1.31%). This is not surprising since a good part of the members of the e-COMS team are lecturers and the portal was officially presented to the university community at the Faculty of Information Science of the University of Granada.

From the library ……...	16	10.53%
From a lecturer ……	113	74.34%
Through the web ……..	7	4.61%
Through another colleague ……	2	1.31%
Others ……..	14	9.21%
Total ……..	**152**	**100.00**%

Table 14. How e-COMS was introduced

It is significant that the portal assessment ranges between excellent and very good, while only very few feel that it is just acceptable or normal (table 17).

Excellent …….	48	31.58%
Very Good ……...	83	54.61%
Good ……	14	9.21%
Normal ……	2	1.31%
DK/NR ……	5	3.29%
Total ……	**152**	**100.00**%

Table 15. Users e-COMS assessment

These data are highly gratifying for the e-COMS team, which is a pioneer in the design of a scholar portal for information literacy. E-COMS, the only information literacy portal in Spain, is an important qualified resource for the progress of the Spanish language community.

- *Assessment as learning resource and employed categories*

As to the benefits of the e-COMS portal as a learning resource, many of the users consider that it is an important resource with quality contents, procedures and resources for their autonomous work (38.10%) and a great help for study (28.95%). This fact precisely validates the objectives and goals of e-COMS, and is an important strength of this portal.

A great help with study ……..	44	28.95%
An important source of quality resources	58	38.16%
Knowledge of new topics ……..	32	21.05%
Others ……...	18	11.84%
Total ……..	**152**	**100.00**%

Table 16. Assessment of e-COMS as a learning resource

It is of interest to know which categories are most used by the students and how many times they visit them. The categories most frequently visited are: *Information-Digital Literacy, Research Initiation, Search and Retrieval, e-Contents, Organization, Filtration and Representation Quality and Assessment and Information Needs*. These are very useful categories for students in Information Science and above all they are necessary for autonomous learning in an e-setting.

	At least once a week	At least once a month	At least once a semester	No response	TOTAL
Information-Digital Literacy	(29) 19.08%	(80) 52.63%	(18) 11.84%	(25) 16.45%	100%
Information Needs	(44) 28.95%	(58) 38.16%	(17) 11.18%	(33) 21.71%	100%
Research Initiation	(3) 1.97%	(78) 51.32%	(40) 26.32%	(31) 20.39%	100%
e-Contents	(29) 19.08%	(65) 42.76%	(16) 10.53%	(42) 27.63%	100%
e-Contents Management	(48) 31.58%	(64) 42.10%	(16) 10.53%	(24) 15.79%	100%
Organization, Filtration and Representation	(48) 31.58%	(64) 42.10%	(34) 15.79%	(16) 10.53%	100%
Search and Retrieval	(66) 43.42%	(39) 25.66%	(16) 10.53%	(31) 20.39%	100%
Quality and Assessment	(68) 44.75%	(48) 31.58%	(30) 19.74%	(16) 10.53%	100%
Editing e-Contents	(33) 21.71%	(50) 32.89%	(33) 21.71%	(36) 23.69%	100%

Table 17. e-COMS categories that are most frequently visited

As regards to the item of portal usefulness, the majority of those surveyed considered that is was of great interest (63.16%) in that it supplies concepts, methods and techniques for

learning to manage and make good use of the enormous and growing amount of available information , thus fostering adaptation to new situations related to information literacy:

Very ……	96	63.16%
Normal ……	24	15.79%
Little ……	32	21.05%
Total ……	**152**	**100.00**%

Table 20.Assessment of e-COMS usefulness

Users were also asked about continuity in use of the e-COMS portal as a learning resource for information skills and competencies, and the majority answered yes, giving it a high value (89%), a fact that reinforces our initial idea about the advisability and need to create on-line educational academic portals to help students becoming information literate.

53. Contents

The users were asked about the organization of the contents of the categories and their responses were highly satisfactory, as can be seen in the table 21. The majority felt that the categories were organized and developed in a very good (44.08%) or excellent (31.58%) way.

Excellent ……	48	31.58%
Very Good ……	67	44.08%
Good ……	24	15.79%
Regular ……	8	5.26%
DK/NR ……	5	3.29%
Total ……	**152**	**100.00**%

Table 19. Assessment of e-COMS categories organization

We were also very satisfied with the results on the item regarding the quality of the resources offered by the portal, since the majority of users considered them to be excellent.

Excellent ……	83	54.61%
Very Good ……	32	21.05%
Good ……	24	15.79%
Average ……	6	3.95%
DK/NR ……	7	4.61%
Total ……	**152**	**100.00**%

Table 20. Assessment of e-COMS quality of the resources

5.4. Visibility

Regarding portal visibility, the users were asked about the entry to the portal from the home page, site map and internal search engine.

As for the use of the forum and it frequency, the data show that only limited use is made since it is not an instrument that the students are accustomed to as a complementary source of learning

Entry from home page	Excellent ……..	47	30.92%
	Very Good …..	38	25.00%
	Good ……..	23	15.13%
	Regular ……..	36	23.68%
	DK/NR ……..	8	5.26%
	Total ……..	**152**	**100.00**%
Site Map	Excellent …….	56	36.84%
	Very Good ……	48	31.58%
	Good ……..	32	21.05%
	Regular ……..	10	6.58%
	DK/NR ……..	6	3.95%
	Total ……..	**152**	**100.00**%
Search Engine	Excellent …….	38	25.00%
	Very Good ……	33	21.71%
	Good ……..	20	13.16%
	Regular ……..	16	10.53%
	DK/NR ……..	45	29.61%
	Total ……..	**152**	**100.00**%

Table 21. Assessment of e-COMS visibility

At least once a week ……..	38	25.00%
At least once a month …….	7	4.61%
At least once a semester …	3	1.97%
Never ……..	104	68.42%
Total ……..	**152**	**100.00**%

Table 22. Use of e-COMS

As to their assessment of the portal's home page, the majority of those surveyed considered it to be excellent (30.92%) or very good (25%), with a smaller group of users considering it average (23.68%). The site map and the search engine are thought to be excellent or very good.

5.5. Navigability

According to the four sub-criteria of menu, navigation buttons, internal links and external links, users opinions show that e-COMS navigability may be regarded as being very good (see in Table 23).

Menu	Excellent …….	56	36.84%

	Very Good …..	40	26.31%
	Good …….....	43	28.29%
	Normal ……	8	5.26%
	DK/NR …….	5	3.29%
	Total …….....	**152**	**100.00**%
Navigation buttons	Excellent ……	45	29.61%
	Very Good …..	55	36.18%
	Good …….....	40	26.32%
	Normal ……	9	5.92%
	DK/NR …….	3	1.97%
	Total …….	**152**	**100.00**%
Internal links	Excellent …….	64	42.10%
	Very Good …..	38	25.00%
	Good …….....	31	20.39%
	Normal ……	11	7.24%
	DK/NR …….	8	5.26%
	Total …….	**152**	**100.00**%
External links	Excellent …….	50	32.89%
	Very Good …..	35	23.03%
	Good …….....	15	9.87%
	Normal ……	22	14.47%
	DK/NR …….	30	19.74%
	Total …….....	**152**	**100.00**%

Table 23. Assessment of the e-COMS navigability

5.6. users' comments

The free text question provided us with some user comments regarding the design and the contents that were useful for improvement proposals. They point to the need to improve the design of the home page to better see the information and if possible they prefer a normal html code since the icons move and the menus open out just by moving the mouse over them, which can be bothersome at times. They also point to the fact that the contents on a single page are too dense and that it would be useful to go more deeply into the contents, grouping them by thematic area and communities of practice.

The data from the on-line questionnaires were put into the MySQL (4.1.18) data base and were processed and analysed using SQL language.

Conclusions

E-COMS is a pioneer tool in information literacy that aims at satisfying the objectives of the EHEA for the autonomous and continuing education of students. Since the portal is in Spanish language, it is understandable that the major visits were made from Spain and Spanish-speaking countries. The performed quantitative analysis shows that there is an acceptable degree of interest on the part of the users, half of whom use it again and/or

devote a significant amount of time to it (between 2 and 20 minutes). Portal visibility is connected primarily with national or Spanish-speaking links, with a clear trend of links to official bodies or universities. Usability allows us to know the strong and weak points of the portal from the point of view of students. From a qualitative point of view, the e-COMS portal responds satisfactorily to criteria of visibility and navigability, and is considered of interest by a large number of students, especially in relation to certain categories, such as information needs, e-content management, organization, representation and filtering, search and retrieval, and finally, quality and assessment.

The usability test and the questionnaire are two complementary methods allowing the uncovering of e-COMS's strong and weak points, according to the users:

Strong points:

- *Contents*: the organization of the categories and the quality of the resources are considered very good.
- *Navigability*: the navigation buttons and links are considered very good, which is important since navigation is the basis of the portal.
- *Questionnaire*: this allows us to learn the opinions of the users and thus adapt the portal to their needs.

Weak points:

- *Loading time*: in both cases, the usability test and the questionnaire, a shorter loading time is demanded.
- *Forum*: because of the users' lack of familiarity with virtual learning, the forum is underutilized.

As a pioneering initiative in Spain in the field of information literacy, the e-COMS portal is an attractive opportunity. One good improvement opportunity is to create an identified access for those users who wish to explore deeper into the information resources. Another would be the implementation of an information form to be filled in by users in order to better know their needs. If these two aspects are joined together, a much more personalized portal will be achieved for the future.

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